REMARKS

Applicants appreciate the thoroughness with which the Examiner has examined the above-identified application. Reconsideration is requested in view of the amendments above and the remarks below.

Rejection under 35 USC § 112, first paragraph

Claims 3 and 4 stand rejected under 35 USC 112, first paragraph, for failing to comply with the written description requirement, namely, for the term heating "without plastic deformation."

Applicants have rewritten claim 3 to delete the term "without plastic deformation" and to describe "induction" heating of the steel. Support is found in the specification at page 11, line 25 to page 12, line 7, wherein the heating is described as being by "a high frequency induction heater." The rejection of claims 3 and 4 under 35 USC 112, first paragraph, is now believed obviated.

Applicant has, however, added new claims 5 and 6, dependent on claims 3 and 4, respectively, describing the induction heating as being "without plastic deformation." Support is found in the specification at page 5, lines 18-28 and at page 11, line 25 to page 12, line 7, where no plastic deformation is described while heating to the Ac3 transformation point or higher.

In response to the examiner's position on applicants' claim to heating "without plastic deformation," the specification does <u>not</u> state that the claimed heating method of the present invention, to a Ac3 transformation point or higher, is during hot rolling. The reference to "a hot rolled wire rod" in the Example is to the fact that the starting material had previously been hot rolled, and not that it was currently undergoing hot

rolling while the described heating was taking place. Wire rod and other steel products that had originally been hot rolled are often subsequently described as such when they are used as the starting materials in other processes, such as the drawing that applicants describe in their Example. Indeed, the cited Kanisawa reference uses the description of "hot-rolled" wire rod or other steels in paragraphs 0005 and 0006 in this manner to describe products that are cooled to room temperature and then further drawn. In the same way, applicants describe in the Example that they start with wire rod that was originally hot rolled, but then describe the subsequent heating method of the present invention as being made with the use of a high frequency induction heater to raise the temperature to a Ac3 transformation point or higher. No plastic deformation is described in connection with such induction heating. Accordingly, the originally-filed specification supports applicants' claim to heating steel to a Ac3 transformation point or higher without plastic deformation.

Applicants' method claims 3-6

Claims 3 and 4 stand rejected under 35 USC § 103 as being obvious from Kanisawa et al. U.S. Patent Publication No. 2002/0040744. Applicants respectfully traverse this rejection.

The claimed method of the present invention as described in claim 3 is distinguished from the prior art Kanisawa process, where in Kanisawa the austenitic range heating is performed while hot rolling the steel wire. Kanisawa describes in paragraph 0033 the hot rolling of the steel to a finish rolling temperature from the Ar_3 transformation temperature to 200°C above it. After quenching, Kanisawa then subjects the steel to tempering and spheroidizing annealing before it is ready for cold forging. Although Kanisawa achieved austenite grain size overlaps with applicants'

invention, Kanisawa's processes for obtaining the fine grain is different. Kanisawa's grain size is achieved by the hot rolling at a temperature of 800°C, whereas applicants' grain size is achieved by a different heat treating method, as described below.

In contrast to Kanisawa's method, applicant induction heats the steel to a Ac3 transformation point or higher so that an austenite grain size is 5 – 20 μm, cools the heated steel; and heat treats the cooled steel, such that tensile strength is 70 – 130 kgf/mm^2 and impact absorption energy is 60 J/cm^2 or more at –40°C, at a tempering parameter (P) ranging from 21,800 to 30,000, where P is expressed by the equation:

$$P = 1.8 \times (T + 273) \times (14.44 + \log t)$$

wherein, T is a tempering temperature expressed in °C and t is a tempering time expressed in sec.

Kanisawa does not disclose or suggest applicants' claimed induction heating to a Ac3 transformation point or higher or tempering parameter (P) and, does not disclose applicants' achieved tensile strength of 70 – 130 kgf/mm^2 and impact absorption energy is 60 J/cm^2 or more at –40°C. As such, Kanisawa does not render obvious applicants' method of claim 3.

Further, applicant's new claims 4 and 5 describe that the induction heating to a Ac3 transformation point or higher is performed without plastic deformation. Since Kanisawa describes only that such heating is during a hot rolling process, he in fact *teaches away* from applicants' process as defined in claims 4 and 5.

Applicants' article claims 1 and 2 (and composition described in claims 3-6)

Claims 1 and 2 stand rejected under 35 USC § 102 as being anticipated by Kanisawa. Applicants respectfully traverse this rejection.

In addition to the amendment to independent method claim 3 and the addition of new dependent method claims 5 and 6 as described above, applicants have amended article claim 1 to recite that the steel wire is a quenched and tempered steel wire which can be cold forged. Support is found in the specification at page 1, lines 10-11, at page 5, lines 18-28 and at page 11, line 25 to page 12, line 7.

Applicant's quenched and tempered steel wire, as defined in claims 1 and 2, and composition claimed in method claims 3-6, is not anticipated by or obvious from Kanisawa. The present invention solves the problem of dramatically deteriorated impact properties when a conventional steel wire for cold forging is used as in automobiles or other devices in a severely cold regions by providing a steel wire having high impact properties of 60 J/cm^2 or more at a cryogenic temperature of -40°C, even though the hot-rolled steel wire is quenched and tempered with high tensile strength of 70 - 130 kgf/mm^2. By contrast, the object of Kanisawa is to provide a steel wire rod for cold forging which can be applied to spheroidizing annealing without a preliminary drawing that is conventionally conducted before the annealing. Notwithstanding overlap in composition and prior austenitic grain size range, the Kanisawa steel wire is incapable of achieving the unexpectedly advantageous claimed properties of applicants' invention.

The differences may be explained by reference to Kanisawa' described treatment processes and reported properties for the steel wire. Kanisawa employs a hot rolling process in which billets of 162 mm x 162 mm in section were heated at a high temperature and continuously plastically deformed by hot rolling into wire rods 11 mm in diameter. The finish hot rolling was at a relatively low temperature of from Ar_3 to 200°C above it (800°C) in order to reach the final size, following by being rapidly

cooled and then tempered at 500°C. After tempering, the wire underwent spheroidizing annealing at the retention temperature of 740°C for a resident time of 17 hours. Kanisawa, Example 1 and Table 2.

The combination of tensile strength and impact absorption energy as defined in the claims of the present invention is also not disclosed or suggested by Kanisawa. Although the steel wire rod produced by Kanisawa immediately after hot rolling, rapid cooling and tempering in Table 3 shows a tensile strength similar with that of the present invention (up to 978 MPa = 99 kgf/mm^2), the steel wire rod cannot be applied to cold forging. Instead, Kanisawa teaches that the wire must undergo spheroidizing annealing, in which case the tensile strength level of the steel wire after annealing and before the cold forging is considerably lower (up to 568 MPa = 57 kgf/mm^2) than applicants' claimed range of 70 - 130 kgf/mm^2.

Notwithstanding the Examiner's opinion, applicants submit that the impact absorption energy of Kanisawa's wire immediately after tempering would not have been at least 60 J/cm^2 at -40°C. Applicant previously submitted the Declaration under Rule 132 of the inventor, Soon-Tae Ahn, that evidences the differences between Kanisawa's disclosed wire and that of the present invention, and the unexpected advantages of the latter over the cited prior art. As described therein, because the method for obtaining the prior austenite grain in Kanisawa is completely different from that in the present invention (hot rolling versus no plastic deformation in the present invention), the Kanisawa microstructure (including the prior austenite grain) immediately after quenching has considerable stress because of severe plastic deformation during hot rolling in low temperature. These stresses will be hardly relieved even though the structure is tempered after quenching, so Kanisawa

acknowledges that the wire must be further spheroidized annealed before it is capable of being cold forged.

By contrast, the microstructure of the present invention does not have Kanisawa's stress in it during the heat treatment step, and therefore has greater ductility. Applicants' claimed impact absorption energy of at least 60 J/cm^2 at -40°C requires significantly more ductility than what is obtained by Kanisawa immediately after tempering.

Although Kanisawa's wire ductility is improved after spheroidizing annealing (when it is ready for cold forging), the tensile strength level of up to 568 MPa (57 kgf/mm^2) is considerably lower than applicants' claimed range of 70 - 130 kgf/mm^2. In summary, Kanisawa only achieves applicants' claimed tensile strength when it has an impact absorption energy lower than applicants' claimed range of at least 60 J/cm^2 at -40°C, and Kanisawa only achieves applicants' claimed impact absorption energy when it has a tensile strength lower than applicants' claimed range of 70 - 130 kgf/mm^2. Only applicant has disclosed and claimed a steel wire for cold forging that has the superior combination of impact absorption energy of at least 60 J/cm^2 at -40°C and a tensile strength of 70 - 130 kgf/mm^2.

Applicants have amended claims in this application. Applicants are not conceding in this application that the claims as they stood prior to amendment are not patentable over the art cited by the Examiner, as the present claim amendments and cancellations are only for facilitating expeditious prosecution and allowance of the claims. Applicants respectfully reserve the right to pursue these prior and other claims in one or more continuation and/or divisional patent applications.

It is respectfully submitted that the application has now been brought into a condition where allowance of the entire case is proper. Reconsideration and issuance of a notice of allowance are respectfully solicited.

Respectfully submitted,

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